

HAER,

OH-

18-CLEV,

32-

Central Furnaces, US Steel Corporation HAER OH-12  
East Bank of Cuyahoga River at 2650 Broadway  
Cuyahoga County  
Cleveland  
Ohio

Photographs and written data

Historic American Negineering Record  
National Architectural and Engineering Record  
National Park Service US Department of Interior  
Washington, DC 20243

ADDITIONAL  
PAGES...

Addendum to

Central Furnaces

On the east bank of the Cuyahoga River at 2650 Broadway,  
approximately 1.25 miles southeast of the Public Square  
Cleveland  
Cuyahoga County  
Ohio

HAER No. OH-12

HAER  
OHIO,  
18-CLEV,  
32-

PHOTOGRAPHS

WRITTEN AND DESCRIPTIVE DATA

Historic American Engineering Record  
National Park Service  
Department of the Interior  
Washington, D. C. 20240

HISTORIC AMERICAN ENGINEERING RECORD

OH-12

CENTRAL FURNACES

HAER  
OHIO  
18-CLEV  
32-

Location: On the east bank of the Cuyahoga River at 2650 Broadway, approximately 1.25 miles southeast of the Public Square, Cleveland.

UTM: 17.443480.4592720  
Quad: Cleveland South

Major Dates of Construction: 1881-1883; 1886-1887; 1900-1911; 1927; 1954.

Present Use: None; plant abandoned October 1978.

Significance: The history of Central Furnaces--in continuous operation for almost one hundred years--illustrates Cleveland's role as one of the Nation's leading iron and steel centers. The plant was established in 1881 by the Cleveland Rolling Mill Company to supply pig iron to its steel works at Newburgh. In 1899, this company was acquired by the American Steel & Wire Company of New Jersey, which in turn was absorbed by the United States Steel Corporation just two years later. After 1933, when the Newburgh steel works closed, Central Furnaces continued to produce merchant pig iron for a variety of foundry customers. Furnace D (1911), still extant, represents one of the early experiments in thin-lined furnace construction. An ore-unloading dock, installed in 1908, features two 10-ton-capacity Hulett unloaded built by the Wellman-Seaver-Morgan Company of Cleveland.

Historian: Carol Poh Miller  
October 1979

#### Author's Note

The author wishes to thank the United States Steel Corporation for its generous assistance during the project. This firm provided a close-up look at both old and new technologies. Ralph Dise, former superintendent at Central Furnaces, accompanied the author on an extensive tour of that facility. His first-hand knowledge of the plant's operation and the many early photographs he supplied were especially valuable. Frederick D. Foote, Manager of Public Affairs for U.S. Steel in Cleveland, arranged access to the Central Furnace plant and to the cache of original engineering drawings still intact at the corporation's Lorain Works. Ernie Buelow, of the engineering department at Lorain, provided copies of many of the drawing. Finally, historic photographs accompanying this report appear through the courtesy of the Cleveland Press, The Plain Dealer, The History Department of the Cleveland Public Library, and the Western Reserve Historical Society.

"Cleveland as an iron centre is already well known, and the general anticipation that the 'Cleveland District' on this side of the Atlantic, will ultimately become as famous for the manufacture of iron as that of the same name in Yorkshire, seems likely to be soon realized."

--Directory of the City of Cleveland  
and Adjoining Towns, for 1872-73

"In our city there is one (enterprise) that for the magnitude of its operations stands ahead of all the others, " the Cleveland historian James Ford Rhodes wrote in 1885.<sup>1</sup> He was writing about the Cleveland Rolling Mill Company, by this date the largest iron and steel manufacturer in Cleveland and one of the five largest in the West.<sup>2</sup>

The Cleveland Rolling Mill Company had its origin in the firm of Chisholm, Jones & Company, founded at Newburgh in 1857 by Henry Chisholm and the brothers John and David I. Jones. (Newburgh, six miles southeast of Public Square, was annexed to Cleveland in 1873.) The Jones brothers had built a rolling mill for the production of T-rails in 1856, but ran out of money. Henry Chisholm's financial assistance, and that extended by Andros B. Stone the following year when the firm took the name of Stone, Chisholm & Jones, insured the stability of the venture. In its earliest years the company employed "about 150 men" and produced about 50 tons of railroad iron daily.<sup>3</sup>

In 1863, Stone, Chisholm & Jones reorganized as the Cleveland Rolling Mill Company. Incorporators included Henry Chisholm, Andros Stone, Stillman Witt, Jephtha H. Wade, and H.B. Payne. Chisholm, (1822-1881), generally credited as the company's organizing genius, was a Scotsman who had emigrated to Montreal in 1842. There he worked as a master carpenter and contractor before coming to Cleveland in 1850 to supervise construction of a breakwater for the terminus of the Cleveland & Pittsburgh Railroad. He later settled permanently in the city. Chisholm served as vice president and general manager of the Cleveland Rolling Mill Company until 1878, when he succeeded Andros Stone as president.

In 1865, the Cleveland Rolling Mill Company constructed the second Bessemer steel works in the United States. By 1866, the company operated two plants, the steel works at Newburgh and the former Lake Shore Rolling Mill on the Lakefront on Wason (now East 38th) Street at the Erie Railroad. Five hundred men, mostly Welsh and Scotsmen, were employed at both works.<sup>4</sup>

A city directory for 1872 notes that the works of the Cleveland Rolling Mill Company by this date consisted of "2 blast furnaces, 2 rail mills, 2 puddle mills, Bessemer Steel Works (with) 2 converters, Wire Drawing Factory, (and a) Spike, Nut and Bolt Factory."<sup>5</sup> By 1879, the company's Newburgh works alone reportedly covered an area of thirty-two acres. Its products included Bessemer steel and iron rails and fastenings, spring steel, horseshoes, tire axles and other forgings, boiler plate, galvanized sheet iron, and corrugated

roofing and siding. Four thousand men were employed and "one hundred and fifty teams," besides locomotives, transported material between the various departments of the works. The wire mills at Newburgh, which had been purchased from the Cleveland Wire Mill Company in 1868, deserved special mention, according to one writer, "for they are the largest of their kind in the country. All kinds of steel wire are made ranging from the coarsest description known down to that of the fineness of a hair."<sup>6</sup>

The success of the company's steel and wire works required a corresponding increase in its capacity for pig iron production. On 15 March 1880, the company directors decided to purchase the "Canal Tract" on the east bank of the Cuyahoga River west of Broadway and north of Jefferson Street. On 27 April 1880, the company increased its capital stock from \$2 million to \$4 million, and in 1881 the erection of a new blast furnace was begun. This was the beginning of Central Furnaces.

Furnace "B," the first furnace at Central, was "blown in" (or ignited) "late in 1882 or early in 1883." It was 75 feet high by 20 feet in diameter and had a capacity of more than 275 tons of iron each day, "whereas none of the old furnaces were good for more than 60 tons." One historian of the industry has noted that Furnace B was "built at the beginning of the trend toward larger furnaces and was important in the annals of the iron and steel industry, not only to Cleveland but to the country at large."<sup>7</sup> Unfortunately, no known photograph of Furnace B survives.

Air for the furnace was supplied by "three of the largest sized blowing engines." It was heated by "Whitewell" stoves. Iron ore was brought to the site by boat and unloaded by "steam hoisting engines, over movable tramways." A "hoist tower" carried the raw materials to the "top house" of the furnace. The new central Furnace, with an annual capacity of 100,000 tons, together with the two furnaces at Newburgh and two others leased from the Cleveland Iron Company, gave the Cleveland Rolling Mill Company a total annual capacity of 175,000 net tons of pig iron.<sup>8</sup>

In 1886-1887, a second blast furnace was built at Central; this was later designated Furnace "C". This furnace was 80 by 20 feet in size and, like Furnace B, had an annual capacity of 100,000 tons. With the dismantling of the two Newburgh furnaces in 1884,<sup>9</sup> the Central Furnaces became the chief supplier of pig iron for the company's Newburgh steel works. By 1893, these works covered seventy-five acres and were in the midst of substantial expansion.<sup>10</sup>

The Cleveland Rolling Mill Company remained independent until 1899, when it was acquired by the American Steel and Wire Company of New Jersey, the largest single producer of steel wire and rods in the industry. This firm, then only recently incorporated, represented a consolidation of the American Steel and Wire Company of Illinois and eighteen other independent companies. The blast furnaces and steel making and rolling facilities of the Cleveland Rolling Mill

Company would furnish the steel required for its Cleveland wire mills, which then included the Consolidated Works, the H.P. Works, (formerly the H.P. Horse Nail Works, founded by Henry Chisholm in 1877) and Newburgh Wire Mill. The acquisition of the Cleveland Rolling Mill Company by American Steel and Wire reflected the general trend in the steel industry of this period toward concentration.<sup>11</sup> Two years later, in 1901 the American Steel and Wire Company was added to the vast holdings of the United States Steel Corporation.

In 1900, American Steel and Wire embarked on an extensive expansion program at Central Furnaces. First, the construction of a new blast furnace was begun. Furnace "A", 100 by 21 feet in size, was blown in on 17 January 1901. In 1904, Furnaces B and C were rebuilt and two Uehling double-strand pig-casting machines were installed, each with a capacity of 57 tons an hour. The dock facilities, which during this period consisted of Brown ore hoists and McMyler unloaders, were augmented with the installation of four Hoover and Mason ore unloaders equipped with 5-ton clamshell buckets. In 1908, the installation of two Hulett ore unloaders led to the replacement of the Brown and McMyler rigs.<sup>12</sup>

The new ore-handling plant at Central Furnaces, which began operating in August 1908, was designed and built by the Wellman-Seaver-Morgan Company of Cleveland. It consisted of two Hulett electric ore unloaders with 10-ton buckets and a 10-ton capacity rehandling and stocking bridge with a main span of 238 feet. Ore taken from the vessels was either loaded into cars running on two tracks at the rear of the unloaders for immediate transfer to the furnaces, or else was deposited into the storage yard and later reclaimed by the stocking bridge. The efficiency of the new unloaders, invented and developed by Clevelander George H. Hulett, caused a reporter for Iron Age to comment that the mouthful of ore brought up by the old-style dump bucket now seemed, by contrast, "scarcely worth while."<sup>13</sup>

In 1911, the American Steel and Wire Company added a fourth furnace at its Central works. Furnace "D," blown in on July 17, received wide attention as "one of the most modern blast furnaces and at the same time most completely equipped with safety appliances."<sup>14</sup> The newest furnace at Central represented the fourth experimental "thin-lined" furnace to be built in the United States.

Furnaces with thin, water-cooled linings had provoked considerable discussion among furnace operators and engineers for more than a decade. The practice had originated in Europe and had been tried in America with mixed success. Proponents of the thin-lined furnace claimed that it was able to maintain a more economical balance of heat (thereby reducing fuel costs) and that it gave greater regularity of production with less variation in the finished product. More cautious operators preferred to wait and see the results of pioneers of the new furnace.<sup>15</sup>

One type of thin-lined furnace that had been developed featured a rolled-steel shell cooled by water circulating through troughs riveted to the lining. Leaks through the rivet holes had developed, however, and American Steel and Wire decided to experiment with a 1-inch rolled steel shell "with holes drilled and tapped in it so that the troughs could be fastened on by means of cap screws. The holes were not drilled through the shell so that there (would be) no danger from leaks."<sup>16</sup>

Furnace D was built for an average daily capacity of 500 tons of iron. Its general dimensions were as follows: height, 93 feet, 6 inches; hearth diameter, 16 feet; bosh diameter, 22 feet; stock line diameter, 16 feet; bell diameter, 12 feet. The furnace, built on ground with an underlying bed of quicksand, was founded on piles averaging 36 feet in length driven so that their tops were 8 feet, followed by two foundation "jackets" filled with "fire-clay paving brick." The furnace columns were designed so that they supported the furnace top and skip bridge separately from the shell.

The bottom, or mantle, ring of the furnace consisted of heavy cast steel in eight sections, bolted together and resting on the furnace columns. Above this, the shell was made of rolled steel; the first ring was 1-1/4 inches thick, the remaining rings were one inch thick. Aside from a trough cast solid with the first (or mantle) ring of the furnace, there were eight troughs, each about 7 feet deep, arranged so that there would be a casing of water not less than 6 inches thick at all points of the shell. The water troughs were fastened to the shell by cap screws. Inside, the furnace was lined with the usual hard-burned brick.

Raw materials for the furnace--ore, coke, and limestone--were deposited by hopper cars into trestle bins. Furnace D operated on the double-skip system, i.e., two skip cars travelled on an inclined skip bridge to the top of the furnace, one car dumping its load of ore, coke, or limestone while the other car made a return trip for more raw materials. A McKee revolving distributor regulated the feed of materials into the furnace. The air for Furnace D was heated by four hot blast stoves of the two-pass, side combustion type, 22 feet in diameter by 100 feet high. Blowing equipment consisted of two horizontal, twin tandem Allis-Chalmers gas engines.

Furnace D's new safety features included items taken for granted in the industry today: covers for all gears, for example, and heavy walks and platforms that made all working parts of the furnace easily and safely accessible to workmen. A bleeder valve at the top of the furnace prevented large pieces of stock from getting out the bell during a "slip," and the bottom of the skip bridge was covered with plates so that any material falling from the skip cars as they travelled to the top of the furnace would roll back down and into a coke buggy by means of a chute. Finally, a bridge was built over the main line tracks of the Newburgh & South Shore Railroad so that workmen could walk from the office and main gate to the furnaces without crossing the tracks.



Photo 7, taken about 1910, illustrates one aspect of the company's campaign for safety on the job.

With the completion of Furnace D in 1911, the Central Furnace plant began operating at record capacity. The plant's output increased to 730,000 tons of pig iron annually. In addition, two Dwight-Lloyd sintering machines, installed in 1913 for "sintering" (or agglomerating) flue dust, were rated at 75,000 tons capacity per year.<sup>17</sup> According to Iron Age magazine, the pig iron cast during the week was delivered by rail in 15-ton ladle cars to the mixers at the Newburgh steel works, a distance of six miles. There, the pig iron was made into steel by either the open-hearth or Bessemer process. The steel ingots were rolled into slabs or billets, then shipped to one of American Steel and Wire's other Cleveland plants for further processing into strip, rods, or wire.<sup>18</sup> The "Sunday Bessemer" iron--the iron which could not be used on Sundays, when the Bessemer converters were down--was cast into pigs.<sup>19</sup>

During the 1920s and 1930s, U.S. Steel's policy of concentrating the operations of its subsidiary manufacturing units led to the disposal of smaller, high-cost and obsolete plants, either by sale or by dismantling. The Depression, and the resulting slump in demand for durable goods, further contributed to the closing of many of the corporation's smaller facilities.<sup>20</sup>

The Cleveland Plain Dealer of 2 December 1932 announced that the city's historic Newburgh steel works would "fall under the wrecker's ax" in 1933, noting that American Steel and Wire's decision rested on the fact that "its equipment is obsolete." The last "blow" at Newburgh was made on 29 April 1933, and the mill was dismantled in 1935-1936. The business of the Newburgh works was transferred to National Tube Company, a U.S. Steel subsidiary in Lorain, Ohio.

At Central Furnaces, which had been the chief source of pig iron for the Newburgh works, Furnaces A and C were abandoned and torn down in 1935.<sup>21</sup> The plant, now consisting of only two furnaces, B and D (Drawing 2), continued to produce merchant pig iron, selling both hot metal and pigs to a variety of foundry customers. The last furnace built at Central was (a new) Furnace "A", erected in 1954 to supply pig iron to the Ford Motor Company's Cleveland Engine Plant. A map of Central Furnaces prepared in 1962 shows that, by this date, Furnace B had been dismantled and the plant was again operating with just two furnaces, A and D.

U.S. Steel abandoned the Central Furnaces in 1978. The company had shut down fourteen of its older, smaller blast furnaces during the previous five years. It continued this "weeding-out" process in 1978 by abandoning several of what it described as "marginal units."

Reasons cited for Central's close were "a continuing deterioration in the market for its pig iron, increasing costs, necessary expenditures for modernization and added expenditures for pollution controls."<sup>22</sup> The last cast at Central was made on 30 September 1978, not long after the plant had been used for on-location filming of the movie The Deerhunter.

The Operation of Central Furnaces, 1964-1978

Prior to closing, approximately 365 men and women were employed at Central Furnaces. Four crews worked twenty-one eight-hour "turns" (shifts) each week. Self-unloading boats delivered Michigan limestone to the north end of the plant, where it was moved about the yard by 10-cubic-yard capacity front-end loaders. Coke from U.S. Steel's coke works at Lorain, Ohio, and Clairton, Pennsylvania, was delivered directly to the trestle bins in hopper cars. U.S. Steel supplied the plant with iron ore from its own mines in the Mesabi Range of Minnesota; company-owned vessels, averaging loads of 14-15 gross tons, brought the ore to the site. Two Hulett unloaders, installed at the south end of the plant in 1908, unloaded the ore. It either transferred into bins near the furnaces for immediate use, or else was deposited into the 700,000-ton-capacity storage yard. The ore bridge initially built as part of the dock was dismantled c. 1954, and tractor scrapers transferred ore to and within the storage yard during the last years of the plant's operation.

Front-end loaders delivered ore and limestone to a row of numbered storage bins parallel to the furnaces. The numbers marked the grade and size of the materials. Ore and limestone then were alternately carried out of the storage bins by conveyor. The material on the conveyor was weighed, then passed to a "tripper car," which distributed it into trestle bins. A "larry car" operator beneath the bins released the desired material by a lever, weighed it, then dropped it through a hopper into one of two skip cars that carried it--in a rough ratio of 20% stone to 80% ore--to the top of the furnace.

A power house erected at Central in 1927 supplied electricity to the Central Furnace plant and to U.S. Steel's Cuyahoga Works and Coke Works, the latter now also abandoned. A Curtis Steam Turbine (last patent date 18 August 1916) manufactured by the General Electric Co. drove a GE alternating current generator. The same building housed the furnace blowing engines, which consisted of one Elliot and two Brown-Boveri steam-driven turbine blowers. The north end of the "Turbo Blower Building," as it was called, housed the plant's machine shop.

During the plant's last years, only two furnaces--A and D--remained in operation. Both were cast (or tapped) six times daily. At Furnace A, the molten iron flowed into eight ladles. Furnace D, able to "spot" (accommodate) six ladles, was shut down in 1974 due to declining orders and competition from imports.

Footnotes:

- 1 "The Coal and Iron Industry of Cleveland," Magazines of Western History 2 (May-October 1885) :343.
- 2 William T. Hogan, Economic History of the Iron and Steel Industry in the United States, 5 vols. (Lexington, Mass., Toronto, and London: D.C. Heath and Company, Lexington Books, 1971), 1:235.
- 3 The early history of the Cleveland Rolling Mill Company is taken largely from William Ganson Rose, Cleveland: The Making of a City (Cleveland and New York: The World Publishing Company, 1950), p.277-278, 322.
- 4 Cleveland Leader, 3 February 1866.
- 5 Directory of the City of Cleveland and Adjoining Towns, for 1872-73 (Cleveland: J. Wiggins & Co., 1872), p. 106.
- 6 Crisfield Johnson, comp., History of Cuyahoga County, Ohio (Cleveland: D.W. Ensign & Co., 1879). p. 308. Also see J.F. Holloway, "Henry Bessemer and His Inventions: A Short Account of the Bessemer Process and the First 'Blow' at the Steel Works of the Cleveland Rolling Mill Co., Cleveland O., paper read before the Civil Engineers Club of Cleveland, 13 May 1884 (Cleveland: Iron Trade Review Print, 1884). The essential operation of a blast furnace is the same today as it was a century ago: Iron ore, coke (for fuel), and limestone (for flux) are charged into the top of a furnace lined with refractory brick (i.e. brick that is capable of enduring extremely high temperatures). Hot air, heated in stoves adjacent to the furnace, is blown in under pressure through openings near the base of the furnace stacks, called tuyeres. The limestone combines with the impurities in the ore (phosphorus, silica, alumina, and manganese) and the ash and sulphur in the coke to form a molten mass lighter than iron, called slag. As the iron oxides are reduced by heat inside the furnace to metallic iron, the iron "drips" down to the hearth, or base, of the furnace where it is periodically cast, or tapped. The molten metal, known as pig iron, flows into a hot metal car (if it is to be taken to a steel furnace for further refinement) or it is collected in ladle cars and taken to a pig-casting machine, where it is poured into molds running on an endless chain. The iron is cooled by jets of water and the hardened "pigs" are dumped into piles for storage or into rail cars for immediate shipment. The fluid slag in the furnace is periodically tapped from a "cinder notch" and allowed to flow into pits, where it is cooled and then carried away.

- 7 William R. Pendry, "A History of the Cleveland District of the American Steel and Wire Company," Cleveland, 1937 (Mimeographed), pp. 51-52. Corroborating Pendry's statements about Furnace B, it has been written that the evolution of the modern blast furnace began about 1880, when capacity furnaces of masonry construction were superseded by larger furnaces of refractory-lined steel or iron plates, similar to today's furnaces. See B.M. Stubblefield's essay on "Pig Iron" in Dan Reebel, ed., A B C of Iron and Steel, 6th ed. (Cleveland: The Penton Publishing Company, 1950), especially pp. 58-59; and Hogan, Economic History of the Iron and Steel Industry, 1:27-31.
- 8 Pendry, "History of the Cleveland District, " pp. 52-53.
- 9 The American Iron and Steel Association, Directory to the Iron and Steel Works of the United States (Philadelphia: Allen, Lane & Scott, 1884), p. 60. This directory reports that the two stacks at Newburgh had been built in 1864 and 1872.
- 10 The Civil Engineers' Club of Cleveland, Visitors' Directory to the Engineering Works and Industries of Cleveland, Ohio (n.p., 1893), pp. 42-43.
- 11 See Hogan, Economic History of the Iron and Steel Industry, 1:257-265. Elsewhere (2:464), Hogan cites a 1911 report by the U.S. Department of Commerce and Labor, which noted that between 1898 and 1900 consolidation in the industry had resulted in the "transfer to less than a dozen concerns more than one-half of the steel-making capacity of the country, so far as primary products are concerned."
- 12 Pendry, "History of the Cleveland District," p. 55.
- 13 Walter G. Stephan, "A 1908 Iron Ore Handling Plant, "The Iron Age 82 (8 October 1908) :985.
- 14 "The Latest Thin-Lined Blast Furnace," The Iron Age 89 (1 February 1912) :287.
- 15 See C.A. Tupper, "Developments in Lining Blast Furnaces," The Iron Trade Review 53 (4 September 1913) :411-413 Thin-lined furnaces already had been installed at the Isabella-Lucy Furnaces of the Carnegie Steel Co., Pittsburgh, and at Furnace No. 6 and 5 (in that order) at the Illinois Steel Co. plant at South Chicago.
- 16 "Latest Thin-Lined Blast Furnace, "pp. 287-288. The description of Furnace D, which follows, is taken from this article, pp. 287-292, and from engineering drawings filed at the Lorian (Ohio) Works of U.S. Steel.

- 17 Supplement to the Directory to the Iron and Steel Works of the United States (Philadelphia: The American Iron and Steel Association, 1903). p. 97; and Pendry, "History of the Cleveland District," pp. 54,55
- 18 Joseph H. Gepfert, "The American Steel & Wire Plants, as We Shall See Them," Cleveland Engineering 23 (23 October 1930) :4.
- 19 "Latest Thin-Lined Blast Furnace," p. 287.
- 20 Hogan, Economic History of the Iron and Steel Industry, 3:1203.
- 21 Pendry, "History of the Cleveland District," pp. 57-58. Building permit records at Cleveland City Hall show that, in 1935, the American Steel and Wire Co. applied for permits to demolish more than a dozen buildings and shops at the plant, in addition to the two furnaces.
- 22 United States Steel Corporation 1978 Annual Report, p. 24.
- 23 This summary of the plant's operation during its last years is based on an interview and plant tour with Ralph A. Dise, superintendent of Central Furnaces from 1964-1978, Cleveland, Ohio, 27 July and 5 October 1979.